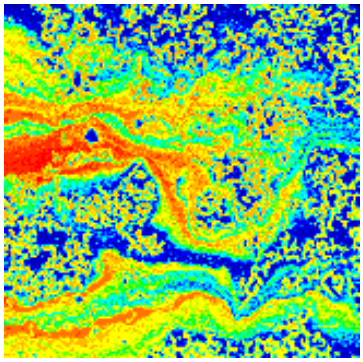
Sandia National Laboratories

Geohydrology Department

Focus

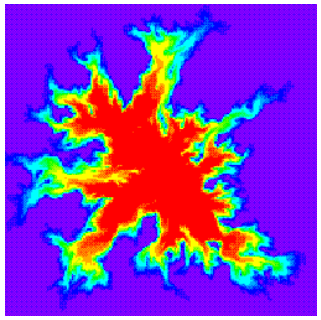
The Geohydrology Department conducts research and solves applied problems in subsurface flow, transport, spatial data analysis, water resources management, site characterization, and decision analysis. Problems addressed include ground-water flow, contaminant transport, enhanced hydrocarbon recovery, environmental restoration, water supply management, disease propagation defense mapping, and nuclear energy and nuclear waste management. Technical capabilities of the Department range from research through development to application. These technical capabilities encompass laboratory experimentation, field experiments, and numerical analysis of various forms. Specific technical strengths include:



High Resolution Digital Image of Solute Transport in a Partially Saturated Fracture

- Flow visualization experiments characterizing multiphase flow and solute transport in discrete fractures, fracture networks, fracture- matrix systems, and highly heterogeneous media.
- Field tracer tests in saturated and unsaturated, porous and fractured media; field-scale vadose zone infiltration experiments with coupled geophysical imaging.
- Spatial statistical characterization and simulation of site-specific physical parameters for input to numerical simulations; probabilistic site characterization and sample program management.
- Advanced pore-scale modeling of multiphase flow discrete fractures, fracture networks, and highly heterogeneous porous media.
- Numerical simulation of nonisothermal, multiphase flow and transport in large, complex subsurface systems on massively parallel computer architectures.
- Three-dimensional numerical modeling of transient, regional-scale ground-water systems, including impacts of long-term climate change.
- Dynamic simulation of water resources and nuclear waste management.

Laboratory and Field Capabilities



Single-Well Tracer Injection Simulation

Flow Visualization and Processes Laboratory: High resolution, real-time digital imaging of flow visualization test chambers • Vacuum chamber for large format fracture casting • Nonisothermal experimental flow chambers • X-ray imaging of multiphase flow and solute transport in solid and fractured rock • Computer image enhancement and analysis hardware and software • Pulse-decay permeameter/ porosimeter • Fully automated, multiscale, gas permeameter for effective property scaling studies.

Field Testing Capabilities: Single and multipacker test tools for *in situ* hydraulic and tracer testing • Tracer infiltration system for tracer injection under unsaturated conditions • Fully instrumented vadose zone infiltration test sites for hydrologic characterization and geophysical imaging.

Sandia is a multiprogram laboratory operated by Sandia corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

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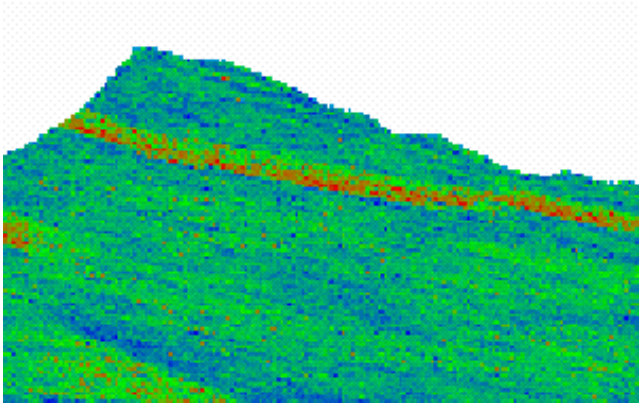
Selected Projects

Multiphase Flow in Single Fractures and Fracture Networks: Laboratory experiments and pore-scale simulation of processes controlling relative permeability, hysteresis, and solute dispersion [Basic Energy Sciences].

Laboratory Testing of Multiphase Properties of Low- Permeability Media: Experimental characterization of multiphase flow of low permeability shear zone material [WIPP International Program; collaboration with NAGRA Grimsel Underground Rock Laboratory, Switzerland].

Multi-Scale Characterization of Ground-Water Flow in Fractured Systems: Field testing and numerical modeling studies of scale dependence of effective hydraulic properties in fractured/double-porosity ground-water flow system [Waste Isolation Pilot Plant].

DNAPL Migration and Remediation in Heterogeneous Porous Media: Flow visualization experiments and up-scaled percolation modeling of Dense Nonaqueous Phase Liquids [DNAPL, e.g. chlorinated solvents] in heterogeneous media [Sandia Laboratory Directed Research and Development; Environmental Management Science Program].

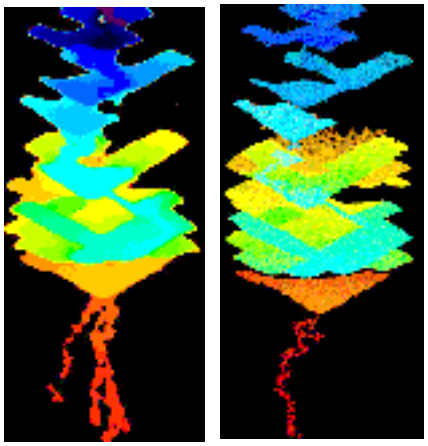


Geostatistical Simulation Permeability Distribution at Yucca Mountain Conditioned on both [Hard] Borehole Data and[Soft] Stratigraphic Information

Numerical Simulation of Thermally Induced Flow in Partially Saturated Media: Drift and mountain scale simulation of thermally driven flow for performance assessment of a high level radioactive waste repository [Yucca Mountain Project].

Three-Dimensional Numerical Modeling of Basin-Scale Ground-Water Flow: Numerical modeling of regional flow system in vicinity of a radioactive waste repository with emphasis on three-dimensional behavior, long-term climate change, and flow through low-permeability confining units [Waste Isolation Pilot Plant].

Field Studies of Vadose Zone Infiltration: Development and application of technology for field-scale infiltration and tracer tests to characterize vadose zone infiltration in alluvial deposits, fractured glacial till, and fractured tuff [Sandia Environmental Restoration Program, DOE Office of Technology Development, DOE Environmental Science Management Program, Yucca Mountain Project].



Chlorinated Solvent Migration in Heterogeneous Media Experiment [left] - Simulation [right]

Nonisothermal Multiphase Multicomponent Flow Simulation on Massively Parallel Computers: Development and testing of advanced flow and transport simulation code for large, complex subsurface flow systems [Sandia Laboratory Directed Research and Development].

Geostatistical Simulation of Physical Property Distributions: Field characterization, analysis of spatial continuity patterns, and modeling of physical property distributions for input to stochastic simulation and uncertainty assessments in flow and transport modeling [Yucca Mountain Project, Waste Isolation Pilot Plant].

Experimental and Numerical Investigations of Multirate Matrix Diffusion: Field-scale tracer tests, x-ray diffusion experiments, and numerical model development characterizing multirate diffusion during contaminant transport in fractured rock [Waste Isolation Pilot Plant; PNC Radioactive Waste Management Project, Japan].

Probabilistic Mapping of Contaminants: Geostatistical analysis of uranium and other contaminants with emphasis on integration of cost/risk/benefit trade-off involved in ongoing site characterization programs [DOE Technology Development, DOE EM40, EPA National Exposure Research Lab, Sandia Environmental Restoration Project].

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